

[0055] Accordingly, a sum of the parasitic capacitances CN formed between the finger 40 and the horizontal wiring line for noise detection DD is made to be equal to a sum of the parasitic capacitances CS formed between the finger 40 and one horizontal wiring, in other words, the area of the horizontal wiring line for noise detection is set to a detecting area, the area of one horizontal wiring subtracted by the sum of areas, at which the vertical wiring lines and the horizontal wiring lines overlap in a horizontal wiring, thereby noise components delivered from the human body can be removed by taking a difference between the noise component output from the wiring line for noise detection and the output detected from each of the horizontal wiring lines by means of the detecting circuit 11.

First Embodiment

[0056] FIG. 5 shows a structure of the pressure-sensitive capacitive sensor according to a first embodiment of the invention. Meanwhile, since the gist of the invention lies in the structure of the capacitive sensor, the gist of the invention is not limited to the present embodiment, and the electric structure is omitted in each embodiment. FIG. 5A is a plan view seen from the first substrate 20 (film shaped substrate) of the capacitive sensor, and FIG. 5B is a cross-sectional view taken along B-B' line of FIG. 5A. The Same reference numerals are attached to the same members as those of the capacitive sensor shown in FIGS. 2 to 4.

[0057] The pressure-sensitive capacitive sensor 1 according to the first embodiment of the invention includes the first substrate 20 where a plurality of vertical wiring lines 22 is formed; and the second substrate 30 where a plurality of horizontal wiring lines 32 is formed. The first and second substrates face each other with a spacer 45 interposed therebetween, and the vertical wiring lines 22 and the horizontal wiring lines 32 are disposed in a matrix. The matrix portion of the vertical wiring lines 22 and the horizontal wiring lines 32 constitutes a sensor unit, and the sensor unit is surrounded by a shield layer 23 formed with a conductive layer.

[0058] In the sensor unit, the capacitance at the intersections between the vertical wiring lines 22 and the horizontal wiring lines 32 is changed according to an applied external pressure, and the change in the capacitance at the intersections between the vertical wiring lines and the horizontal wiring lines is detected by a detecting circuit (not shown), the detecting unit. And then the externally applied pressure distribution is detected on the basis of the detecting result.

[0059] In addition, a horizontal wiring line 50 for noise detection is disposed on a surface where the horizontal wiring lines 32 of the second substrate 30 are formed. In the capacitive sensor 1 having the above structure, the vertical wiring lines 22 are not disposed at a position facing the horizontal wiring line 50 for noise detection.

[0060] As a result, the horizontal wiring line 50 for noise detection does not cross the vertical wiring lines 22, thereby signal components from the vertical wiring lines 22 are not flowed into the horizontal wiring line 50 for noise detection, and only noises delivered from the human body via the finger can be detected by the horizontal wiring line 50 for noise detection when the capacitive sensor is used as a fingerprint sensor. Accordingly, a structure of the detecting circuit for carrying out subsequent signal processing can be simplified.

[0061] In the capacitive sensor 1 having the above structure, the first substrate 20 has flexibility because of the horizontal wiring lines 22 formed on the film 21, and a surface of the first substrate 20 is to be a contacting surface of a detecting target (e.g. fingerprint of the finger). Reference numerals 24 and 33 denote insulating layers.

[0062] Accordingly, when the capacitive sensor 1 is used as a fingerprint sensor, the first substrate 20 changes the shape in response to the unevenness of the fingerprint of the finger, a detecting target, and the pressure distribution can be detected accurately.

[0063] In addition, in the capacitive sensor 1, the area of the horizontal wiring line 50 for noise detection is set to a detecting area, the area of one horizontal wiring subtracted by the sum of areas, at which the vertical wiring lines and the horizontal wiring lines overlap in a horizontal wiring 32.

[0064] Accordingly, when the capacitive sensor 1 is used as a fingerprint sensor, regardless of the change in the unevenness of the first substrate 20 (film substrate) by the fingerprint when the finger comes in contact with the sensor unit, the capacitance between the finger and the horizontal wiring lines 32 is almost equal to the capacitance between the finger and the horizontal wiring line 50 for noise detection, and the amount of noises delivered from the finger to the horizontal wiring lines 32 is almost equal to the amount of noises delivered from the finger to the horizontal wiring line 50 for noise detection.

[0065] As a result, a difference between the amount of noises delivered to each of the horizontal wiring lines and the amount of noises delivered to the horizontal wiring line for noise detection can be taken by subsequent signal processing carried out by a detecting circuit (not shown), thereby the noises delivered from a human body can be easily removed.

Second Embodiment

[0066] Next, FIG. 6 shows a structure of the pressure-sensitive capacitive sensor according to the second embodiment of the invention. FIG. 6A is a plan view of the sensor unit of the capacitive sensor, and FIG. 6B is a cross-sectional view taken along line C-C' of FIG. 6A.

[0067] The capacitive sensor according to the second embodiment differs from the capacitive sensor according to the first embodiment in that vertical wiring lines and the horizontal wiring lines are divided into two areas in the first and second substrates, respectively, and are disposed in a matrix, and the horizontal wiring line 50 for noise detection is disposed at a position corresponding to an interface (i.e. central position) between the two areas in the second substrate 30 such that it does not cross the vertical wiring lines, and the rest structures are the same thereby overlapping descriptions will be omitted.

[0068] In FIG. 6, same reference numerals are applied to the same components as the capacitive sensor shown in FIG. 5. The same is applied to the following embodiments below. In FIG. 6, the first substrate 20 is divided into two areas as right and left areas in FIG. 6A, and vertical wiring lines 22A and 22B are formed in the respective areas on the film 21.

[0069] In addition, the second substrate 30 spaced apart from the first substrate 20 where the vertical wiring lines are